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Warming could push Greenland ice sheet beyond ‘tipping points’

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Global warming could melt the vast Greenland ice sheet beyond ‘tipping points’ from which it would only partially recover, even if global carbon dioxide concentrations returned to levels prior to the industrial revolution — a new study has found.

Previous studies have already shown that the ice sheet, covering an area of about 1.7 million km^2, could melt completely over a few thousand years if global temperatures rise unchecked. This would raise sea levels by up to seven metres.

This latest study used a sophisticated climate model coupled to a 3D simulation of the ice sheet to predict changes over thousands of years — a method pioneered by the Met Office Hadley Centre. Scientists found there were ‘tipping points’ in the melting of the ice sheet which, when crossed, meant that the ice sheet may only recover to certain levels even when temperatures returned to pre-industrial levels.

- If the ice sheet shrinks by more than 15% (which could occur within 300 years) it would be locked into a decline from which it could only recover to 80% of its current size. This would cause a 1.3-metre sea-level rise.
- If the ice sheet reduces to about 50% of its current size it would be locked into further reduction, only stabilising again at 20% of its current size — creating a sea-level rise of five metres.

This damage could only be undone if the global temperatures plunged back into an ice age — where temperatures would be cool enough for the ice to rebuild. Current predictions estimate this is unlikely to happen for tens of thousands of years.

Jeff Ridley, a Met Office Climate Scientist specialising in polar regions, said: “The effects of the greenhouse gases we emit today will still be felt long into the future, so we will need to start taking action now to stop temperature rises that will still be happening at the end of this century. Only by tackling warming temperatures now can we prevent the ice sheet melting past these tipping points, and prevent irreversible sea-level rise.”

Our expertise in this area is now being used to assess how global warming could impact the world’s biggest ice sheet, in the Antarctic. Covering an area of about 14 million km^2, it contains about 60% of all the fresh water on Earth and any melting could have a significant effect on sea levels.

Thresholds for irreversible decline of the Greenland ice sheet (external site).